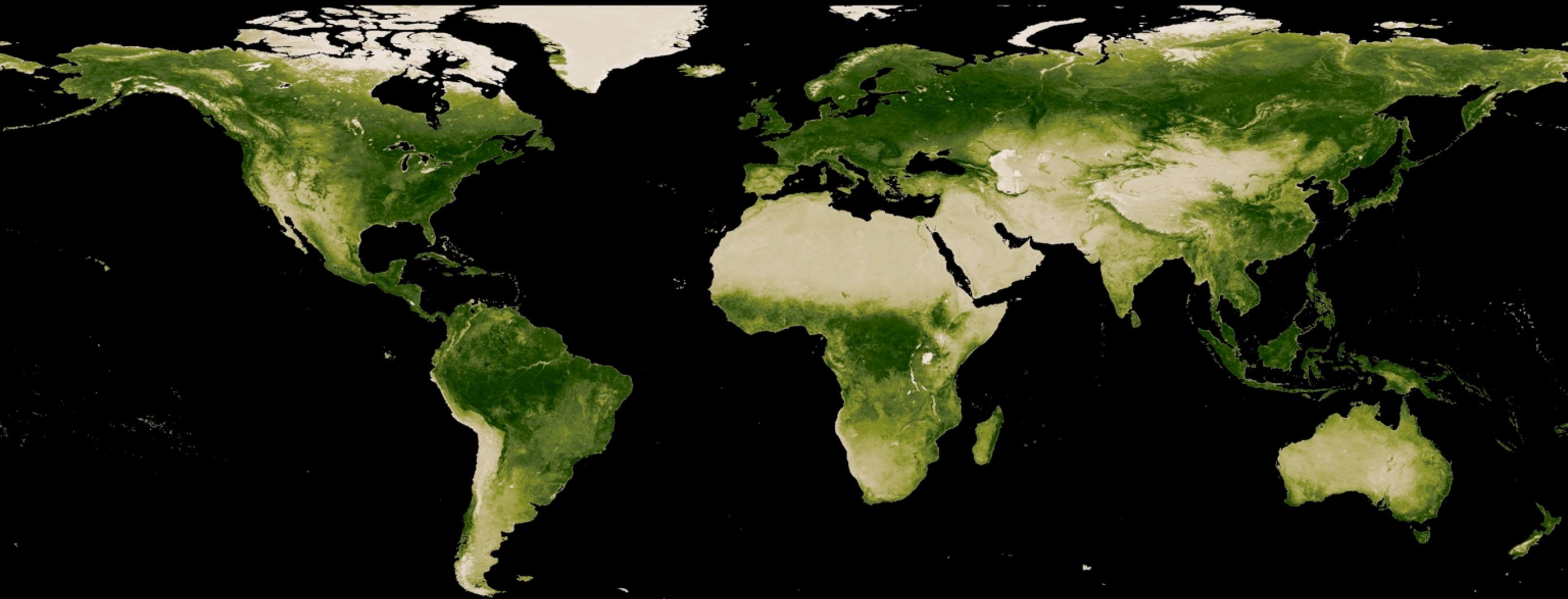
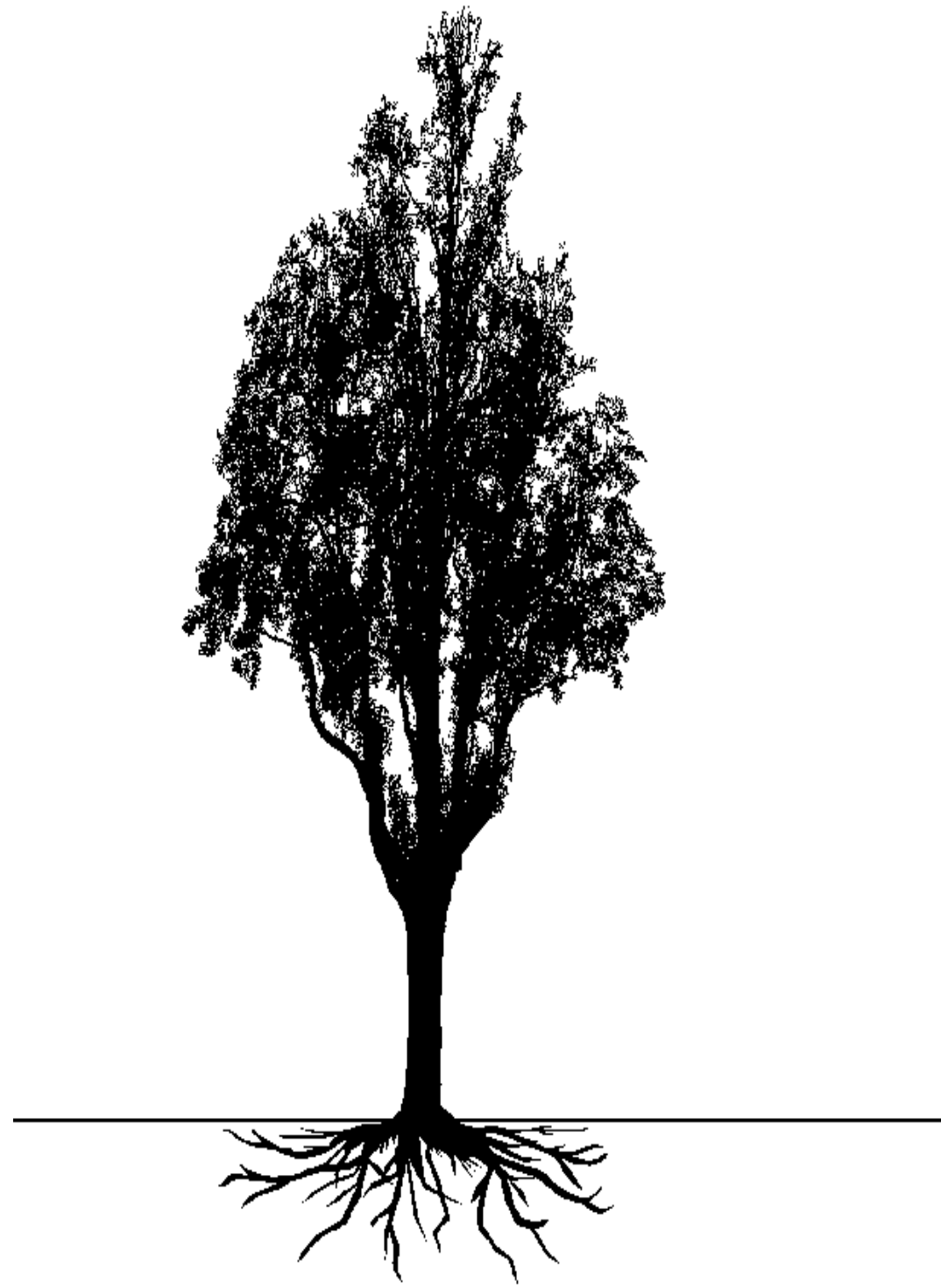


Quantifying the Role That Terrestrial Ecosystems Play in Earth's Climate

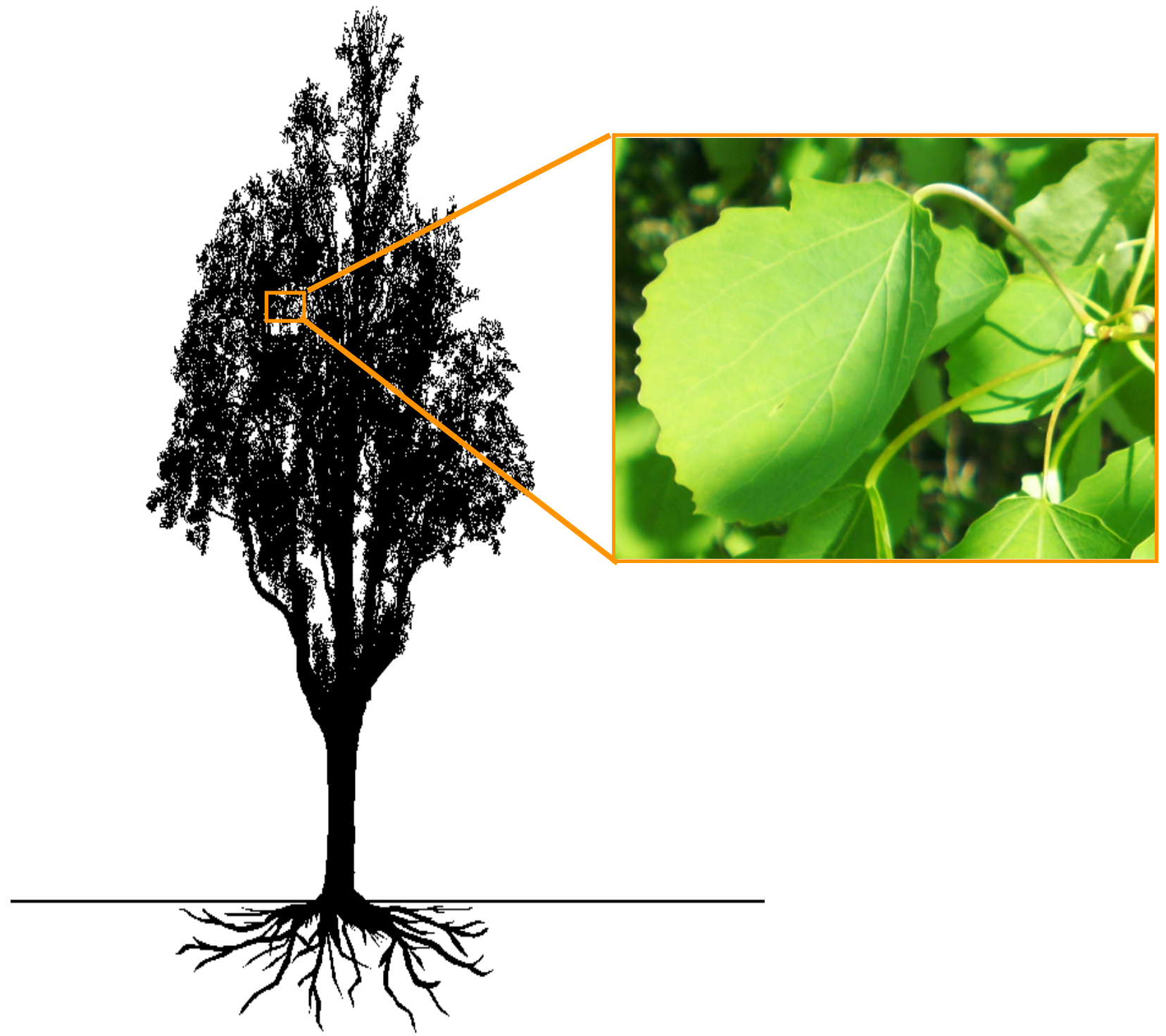


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Think like a tree



Think like a tree



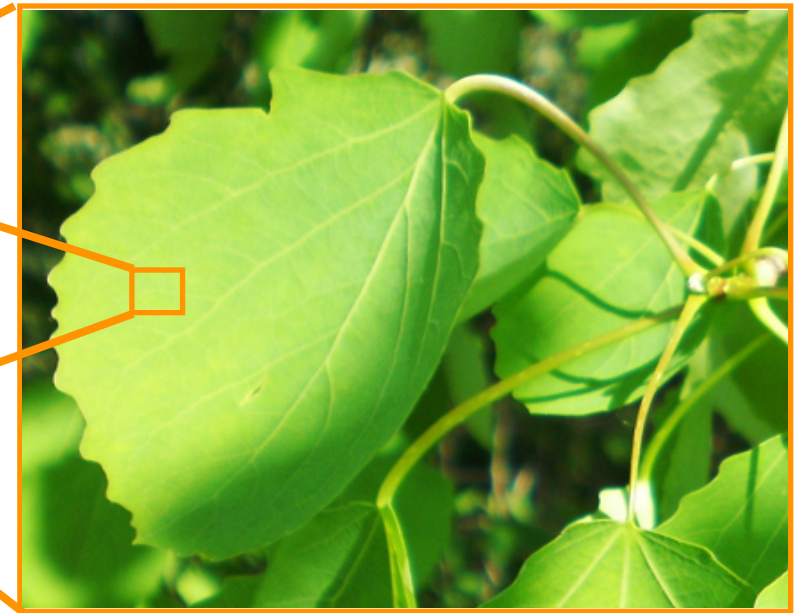
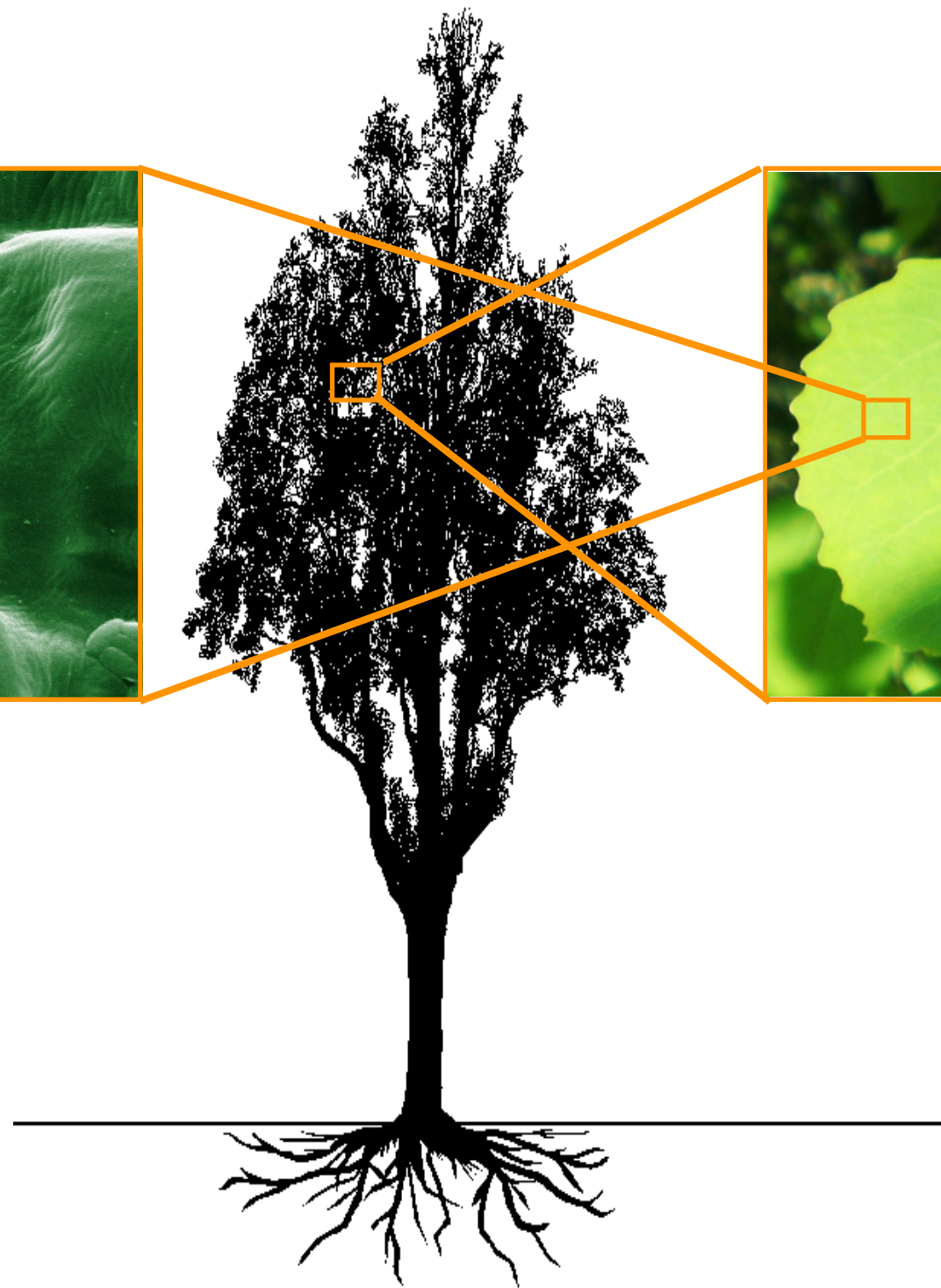
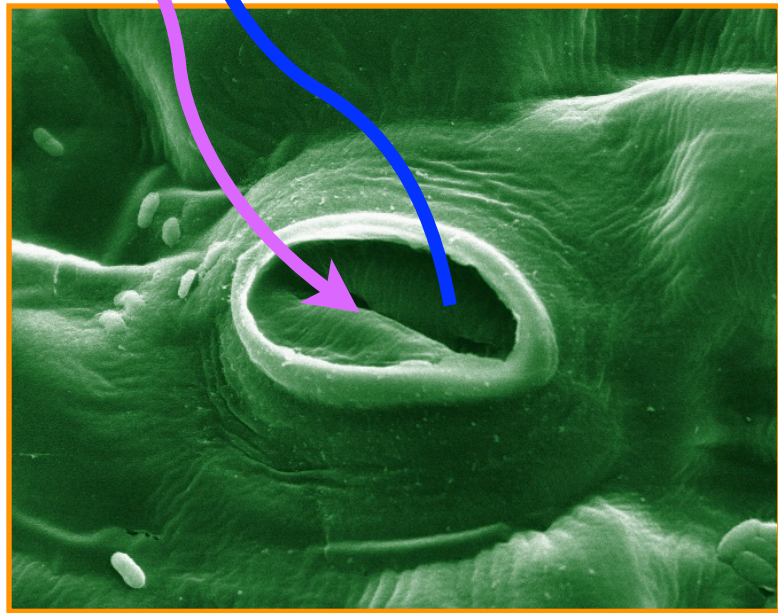
Think like a tree: Carbon in, water out

Photosynthesis

CO_2

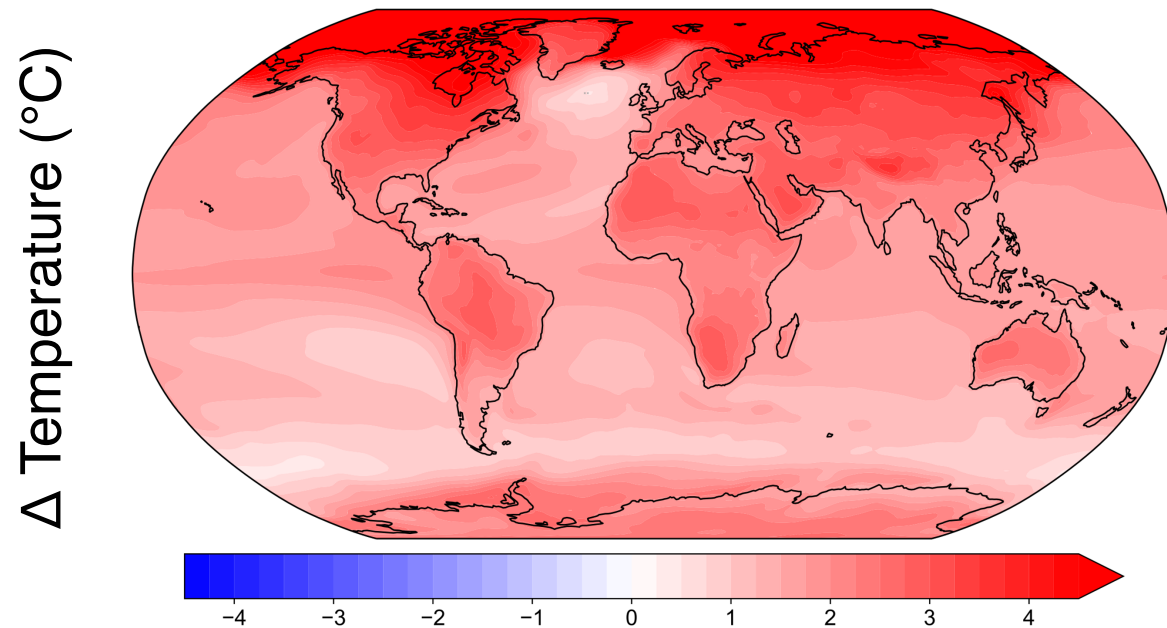
Transpiration

H_2O

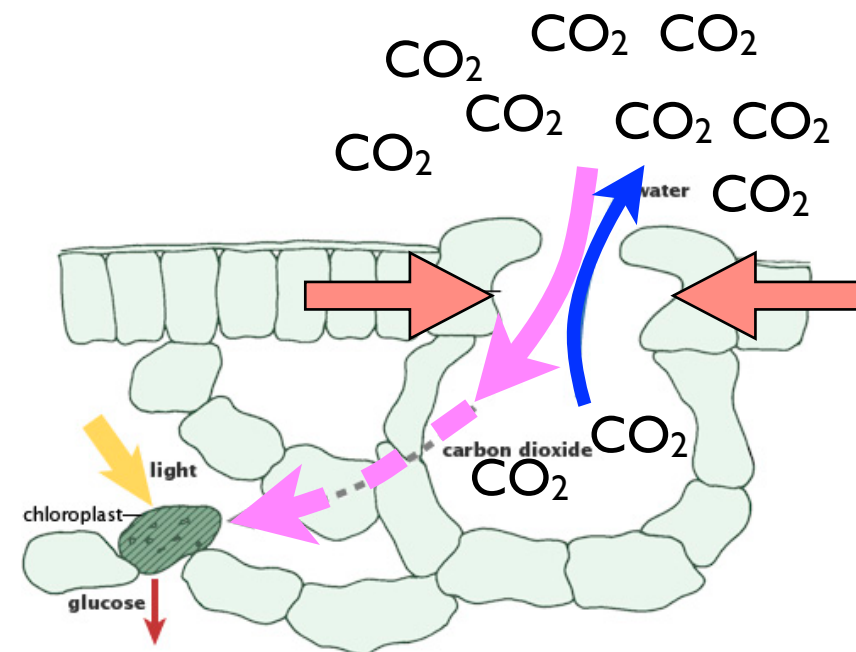


CO₂ has multiple effects

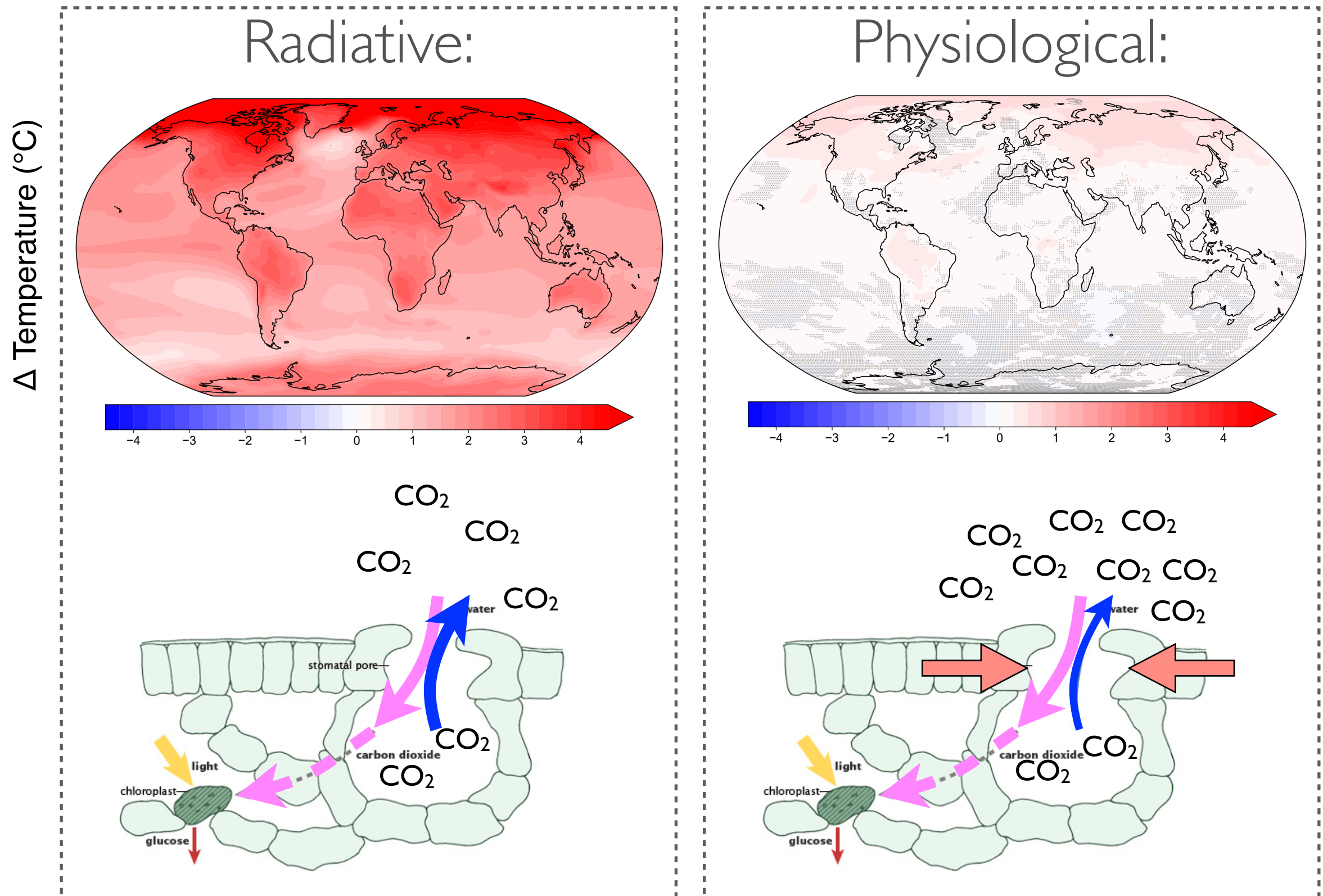
Radiative:



Physiological:



Some warming just from stomata closing



Increase in temperature in 12 CMIP6 models due to $2\times\text{CO}_2$

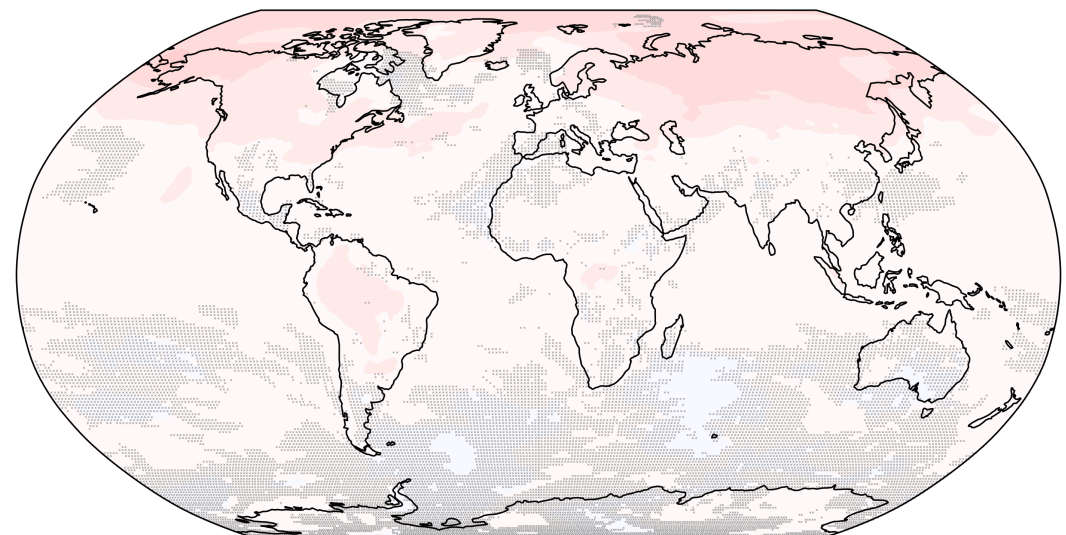
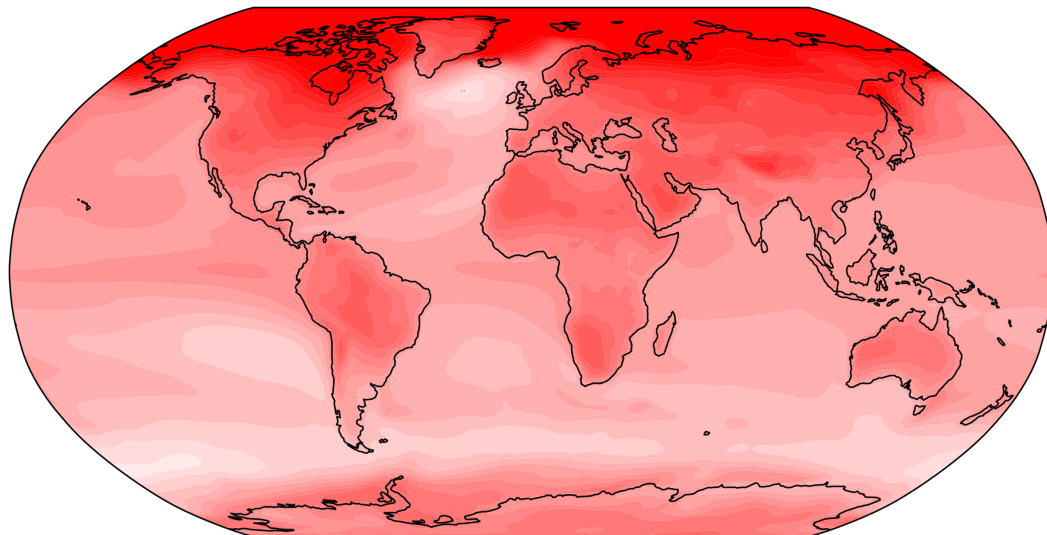
Zarakas et al. 2020 *J.Clim*
Swann et al. 2016 *PNAS*

Up to 20% of the warming w/ CO_2 is due to plants!

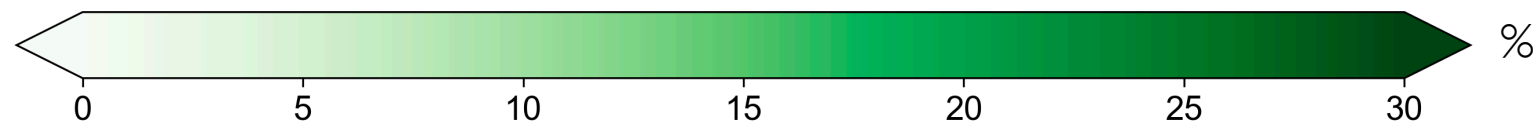
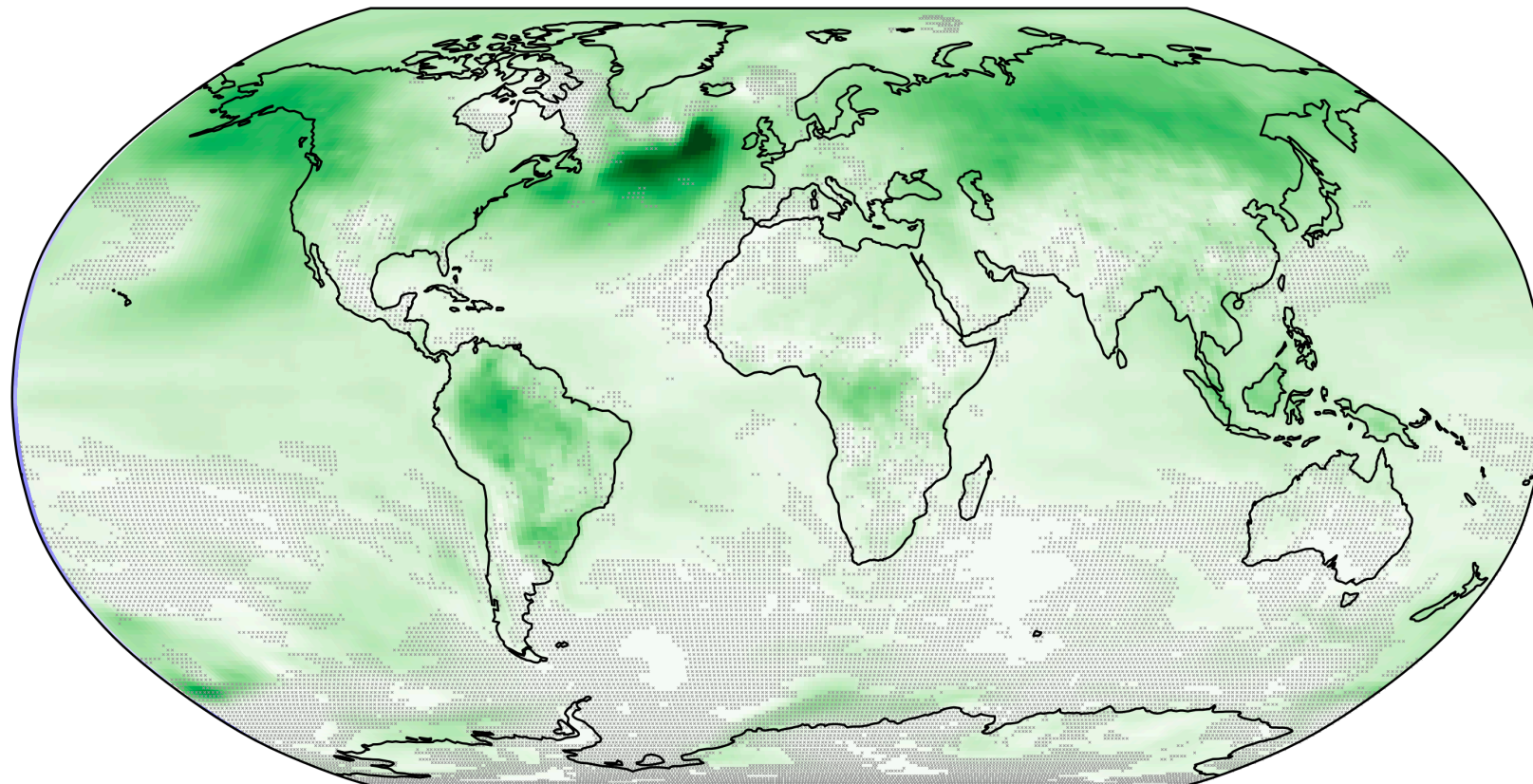
Radiative:

Physiological:

Δ Temperature ($^{\circ}\text{C}$)



Physiological
Contribution
to Total
Warming at
 $2\times\text{CO}_2$ (%)



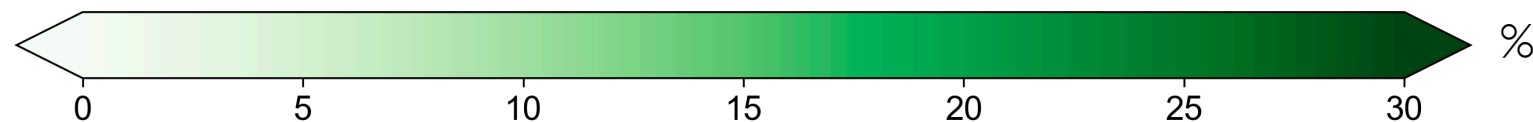
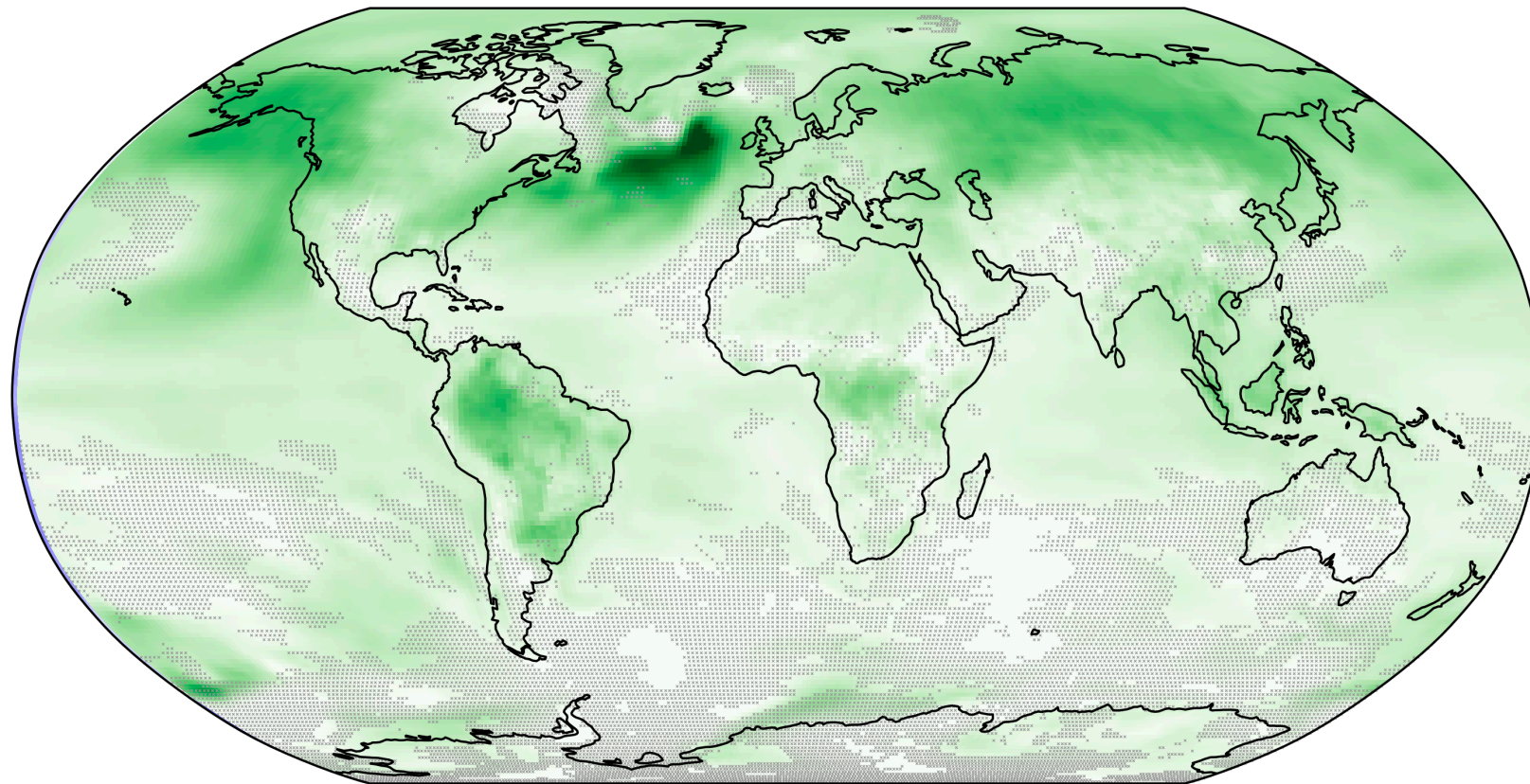
Up to 20% of the warming w/ CO_2 is due to plants!

Radiative:

Physiological:

Plant responses are **very uncertain** \Rightarrow typically not accounted for in uncertainty in temperature (drought, etc) under future climate

Physiological
Contribution
to Total
Warming at
 $2\times\text{CO}_2$ (%)

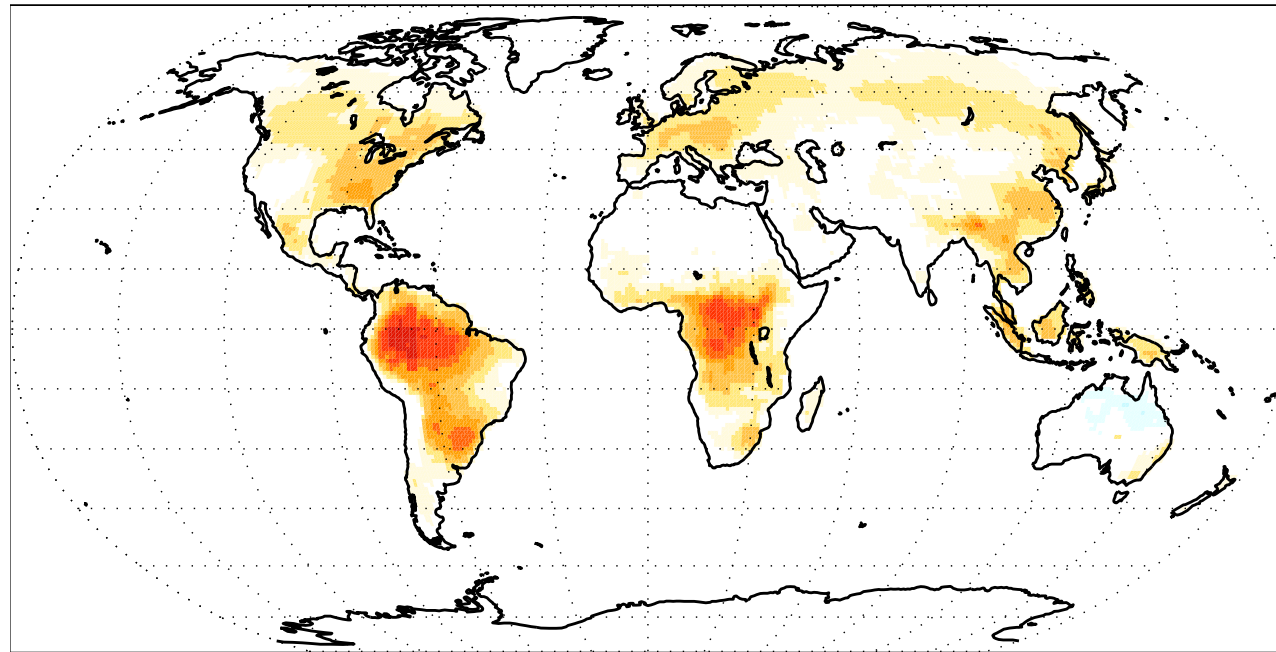
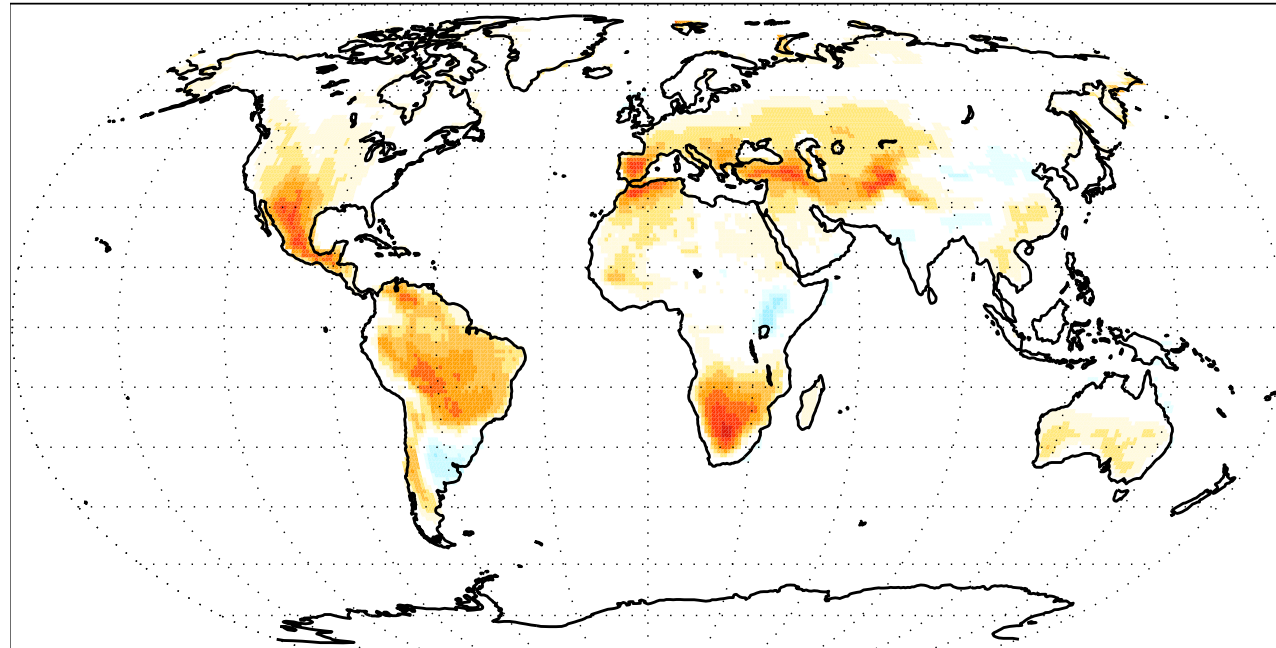


Some atmospheric variables respond strongly to plants:

About *half* of RH change is from plants closing stomata

Radiative

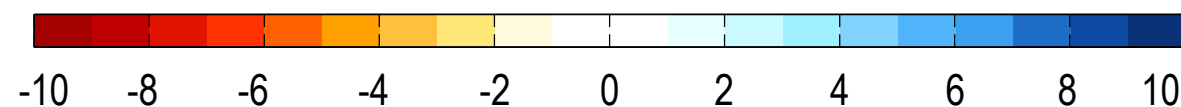
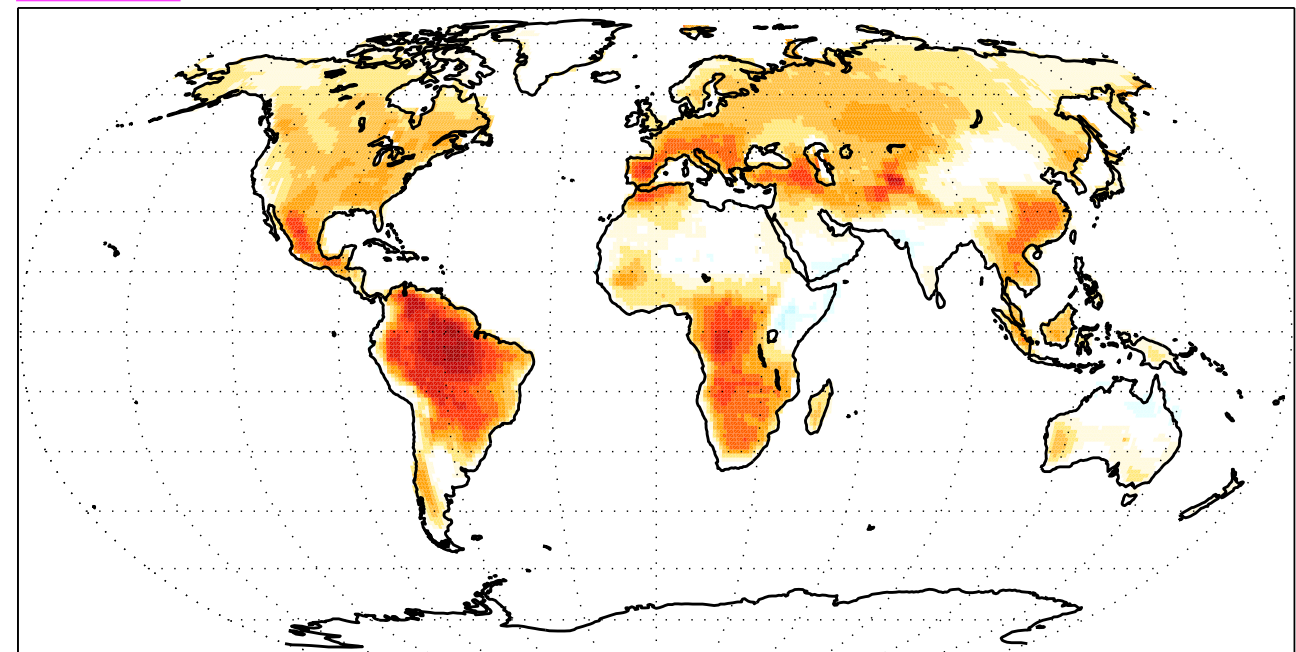
Δ Relative Humidity (%)



Physiological

Both

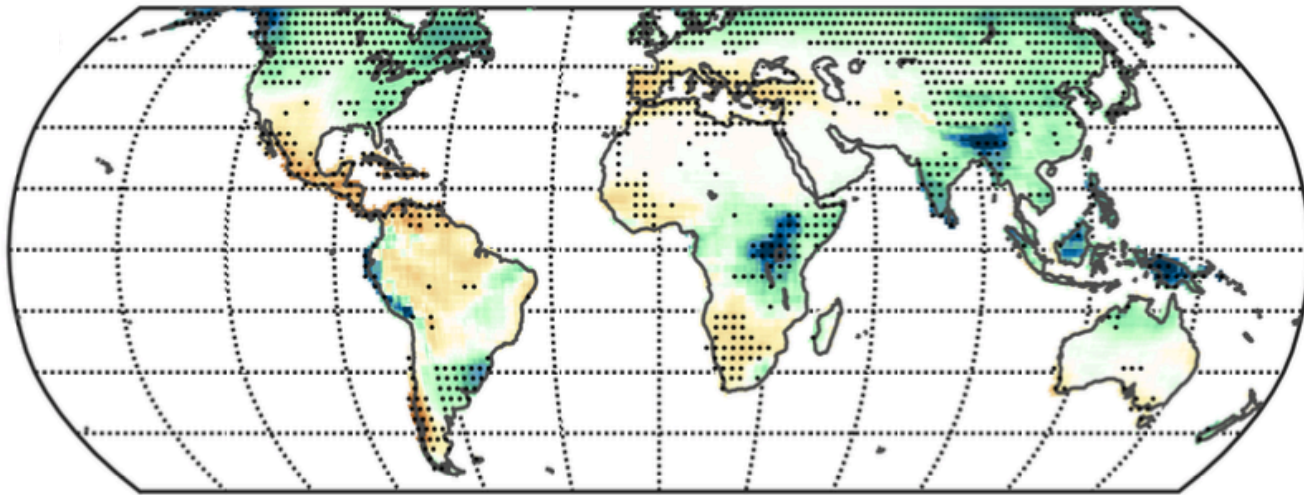
Δ Relative Humidity (%)



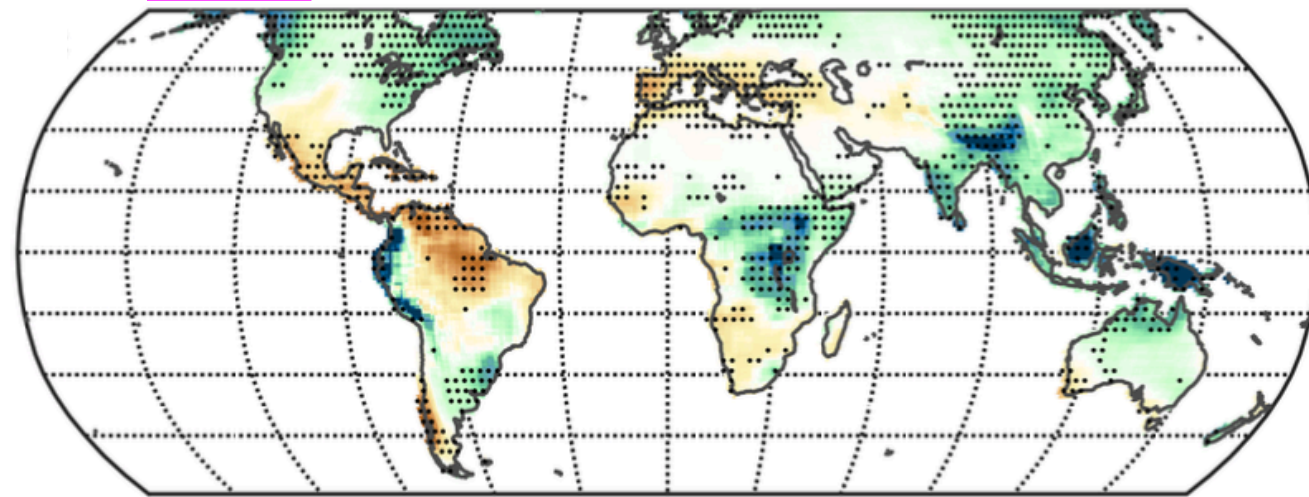
Tropical Precipitation has a big signal from plants!

And it's all local to each continent, not due to circulation

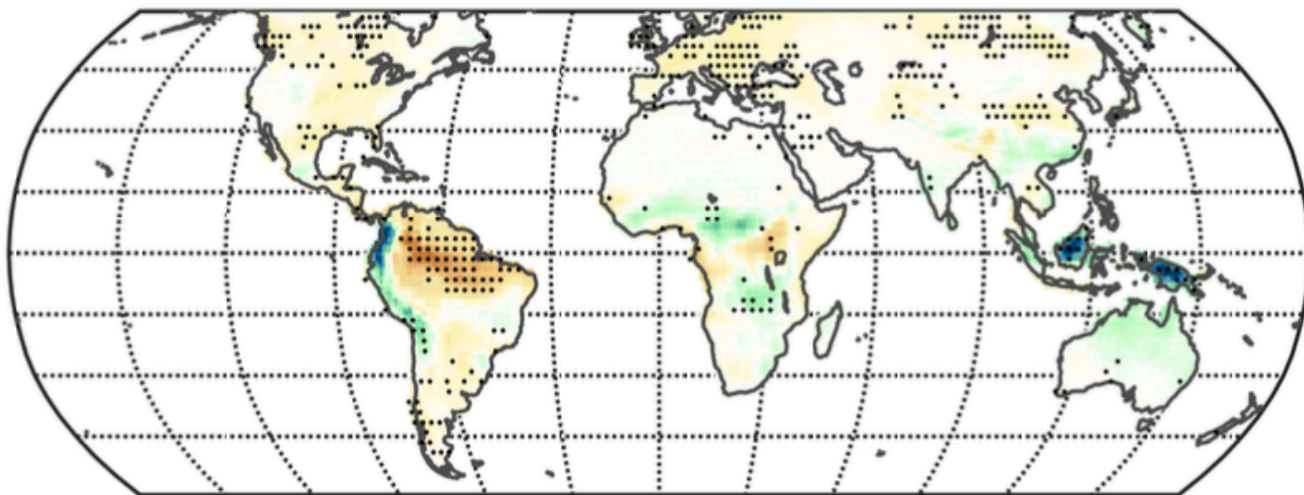
Radiative



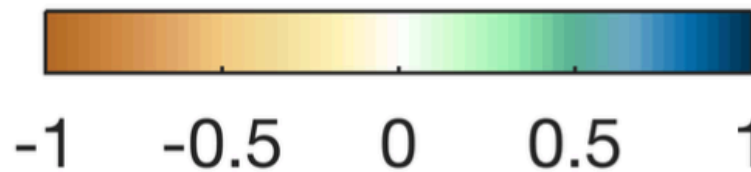
Both



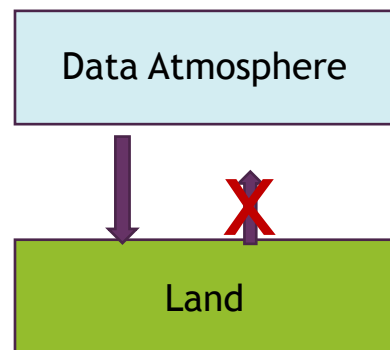
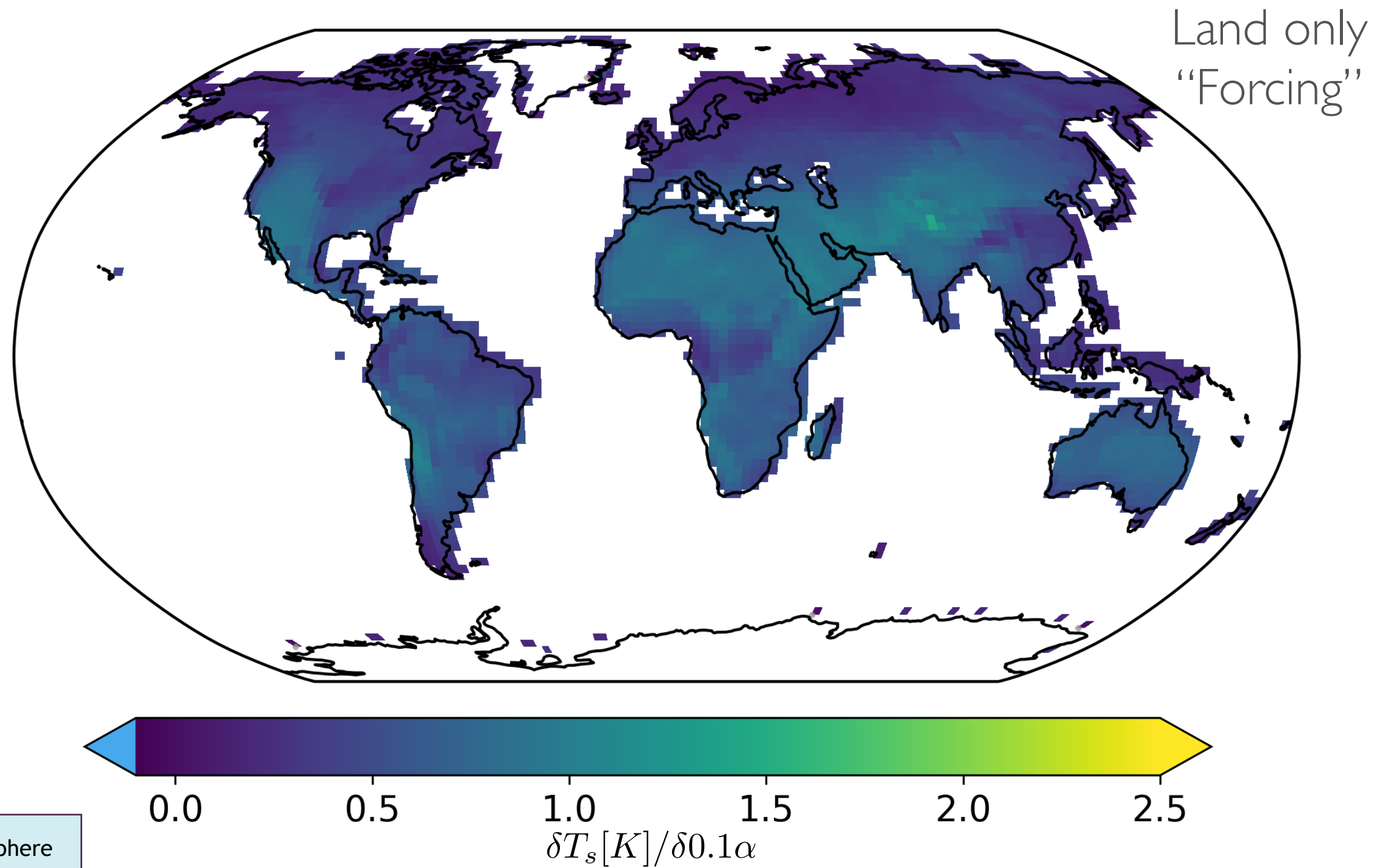
Physiological



mm day⁻¹

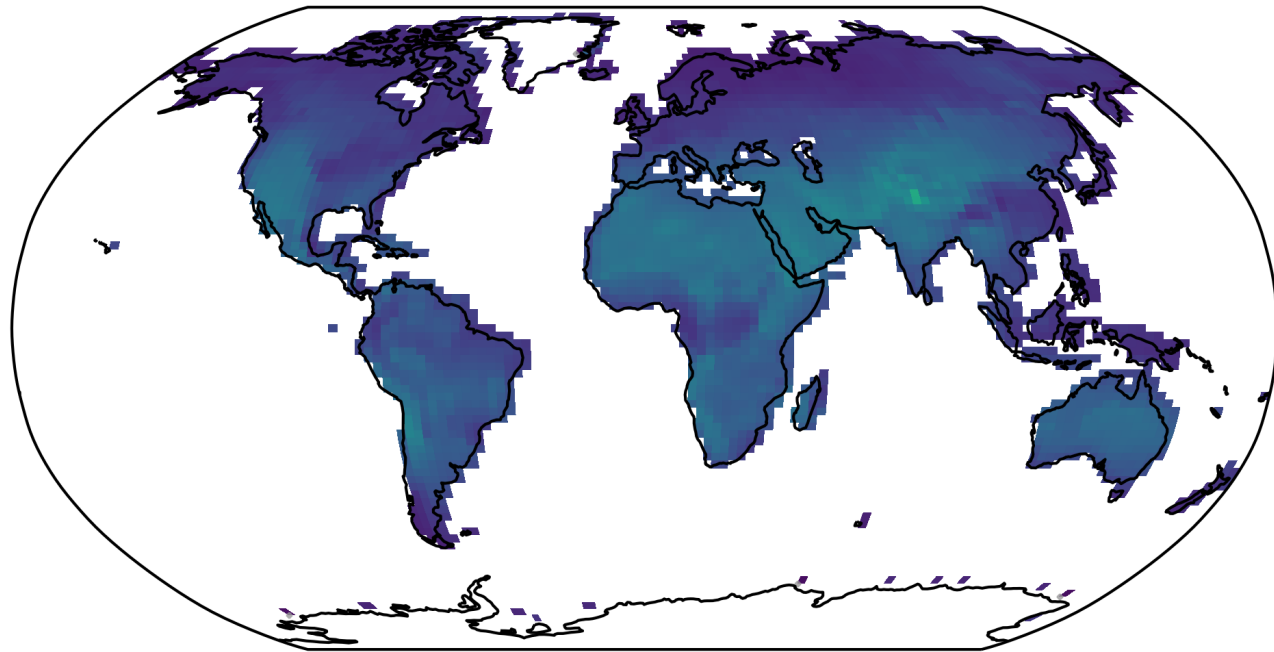


Temperature response to a change in surface albedo of 0.1

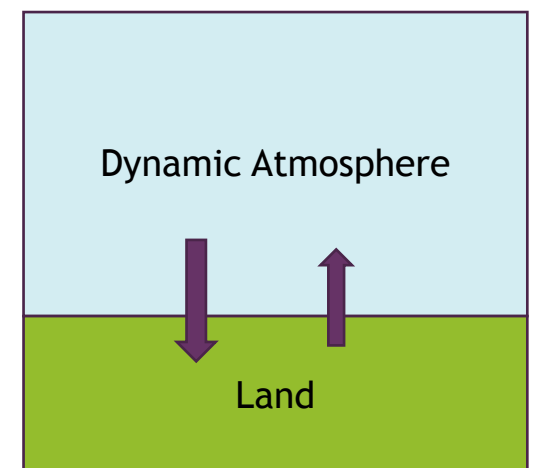
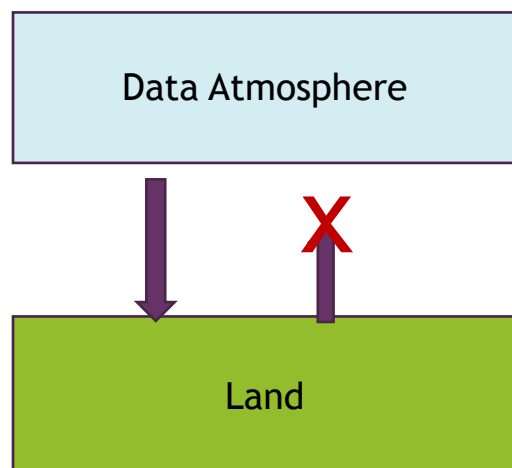
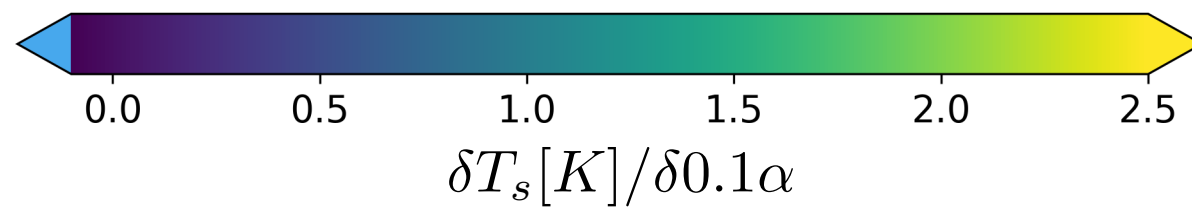
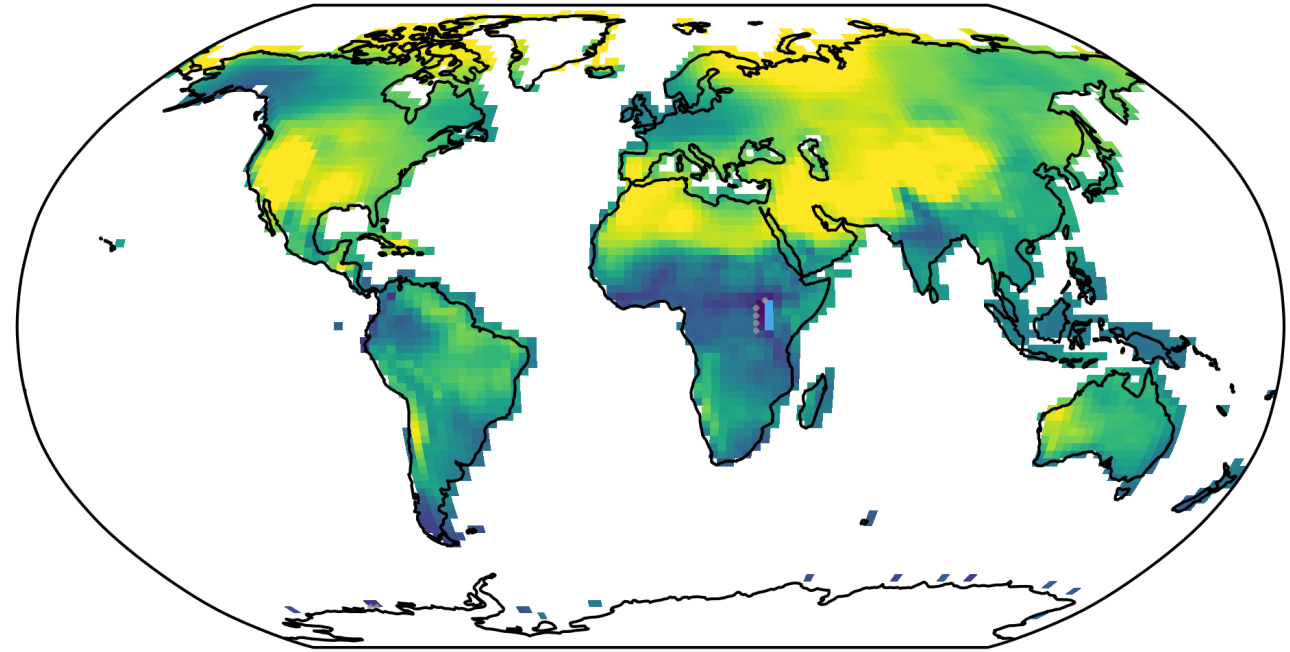


Feedback from the atmosphere is large!

Land only
“Forcing”



Land + Atmosphere
“Forcing + Feedback”



Take home points

- Plant responses to climate can have a big impact on surface climate but are *highly uncertain*
- Plants impact many aspects of physical surface climate
- Changes in land surface properties (either prescribed or varying) can impact surface climate both directly and through atmospheric feedbacks